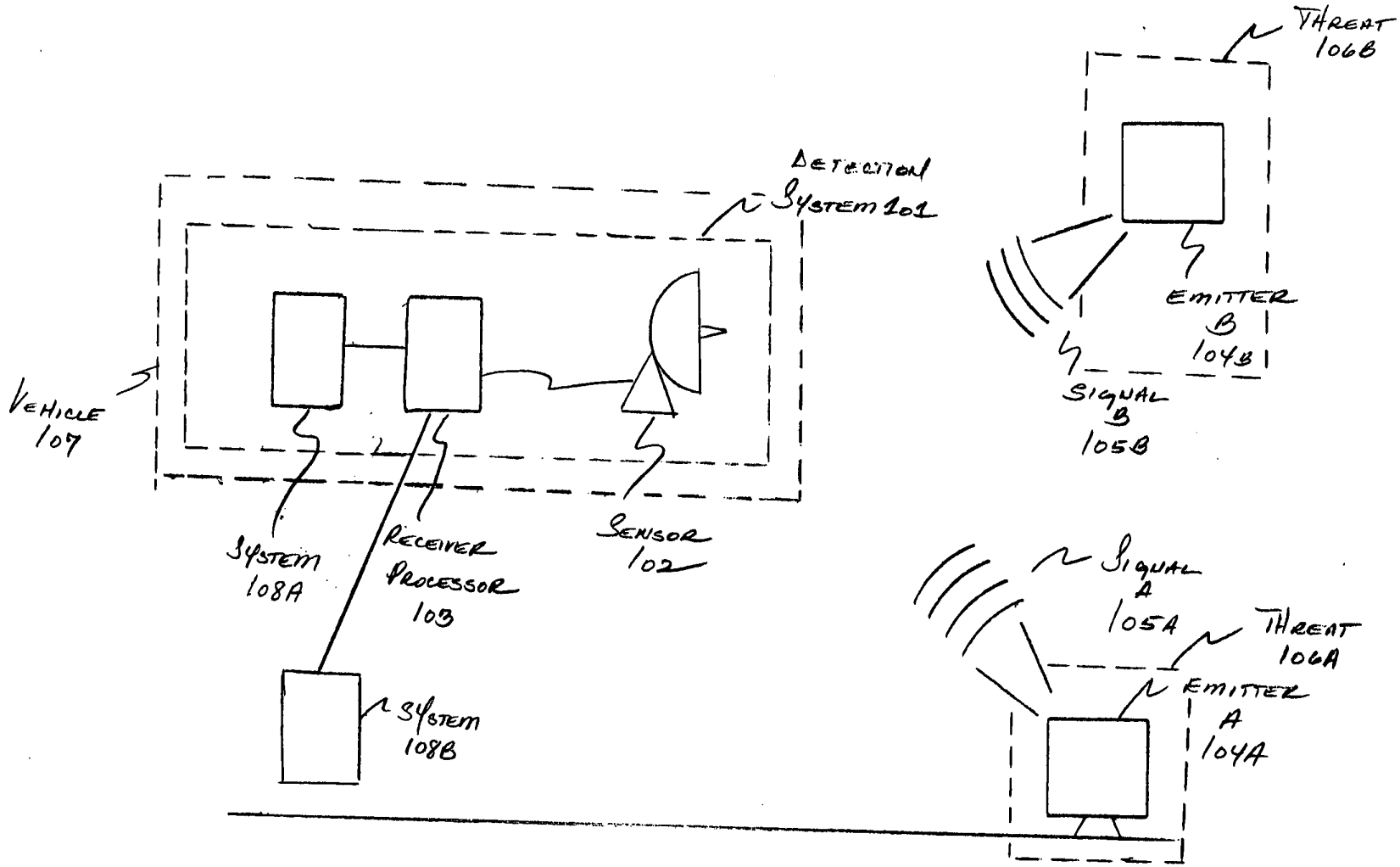

Detection
System 101
Vehicle
107
System
108A
Receiver
Processor
103
Sensor
102
System
108B
Threat
106B
Emitter
B
104B
Signal
B
105B
Signal
A
105A
Threat
106A
Emitter
A
104A

Figure 1

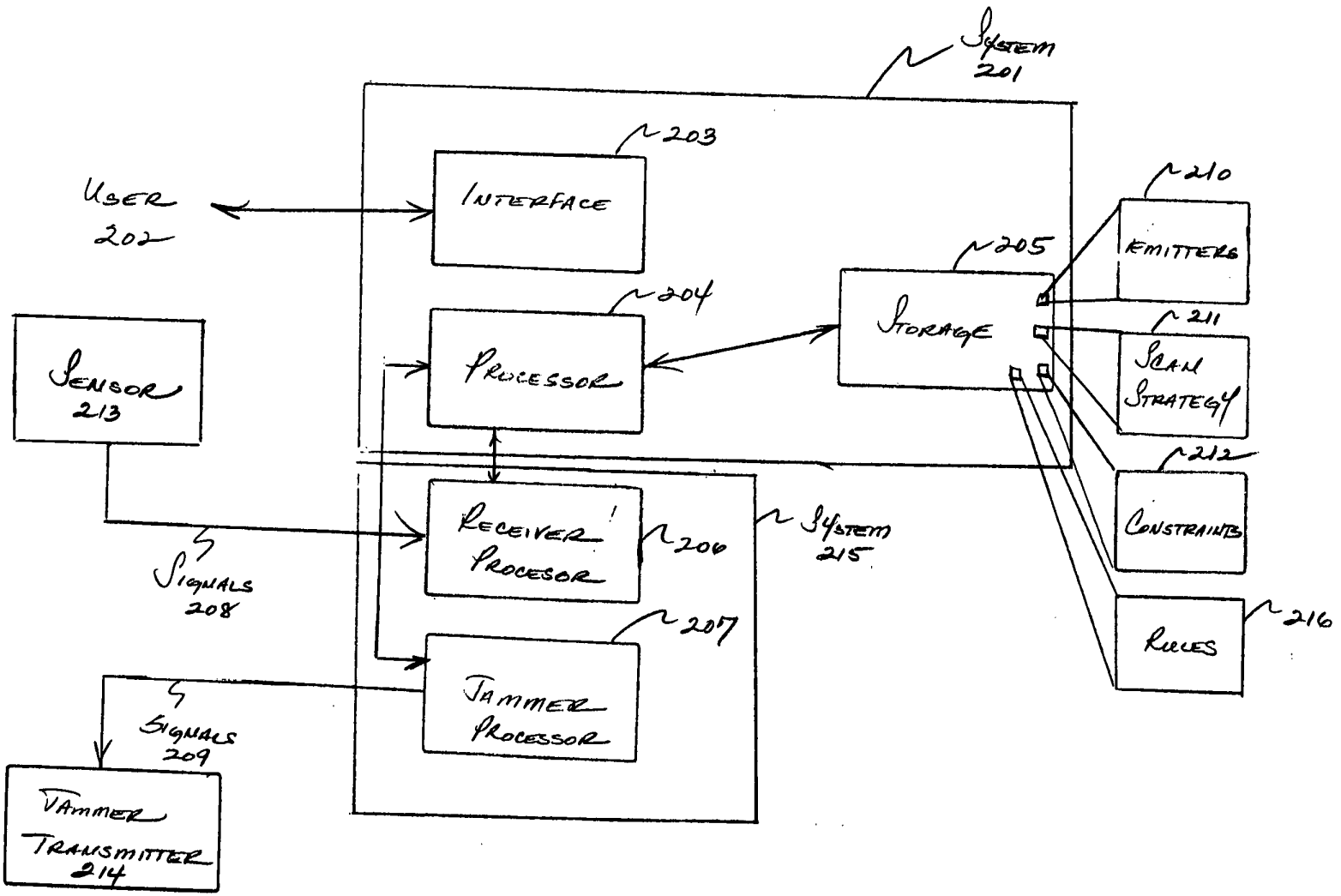

System
201
203
Interface
User
202
210
Emitters
205
Storage
204
Processor
211
Scan
Strategy
Sensor
213
212
Constraints
Receiver
Processor
206
System
215
Signals
208
207
Jammer
Processor
216
Rules
Signals
209
Jammer
Transmitter
214

Figure 2

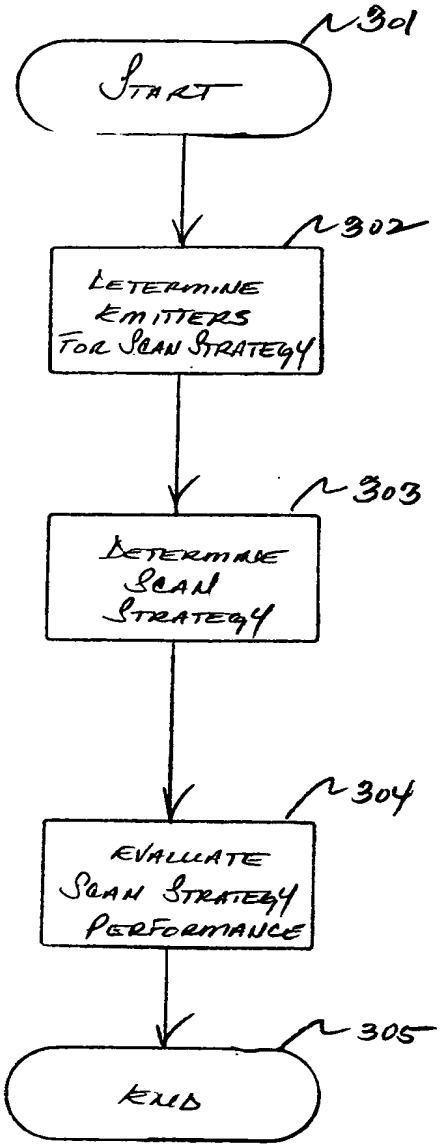

301
START
302
DETERMINE EMITTERS FOR SCAN STRATEGY
303
DETERMINE SCAN STRATEGY
304
EVALUATE SCAN STRATEGY PERFORMANCE
305
END
PROCESS 300

FIGURE 3

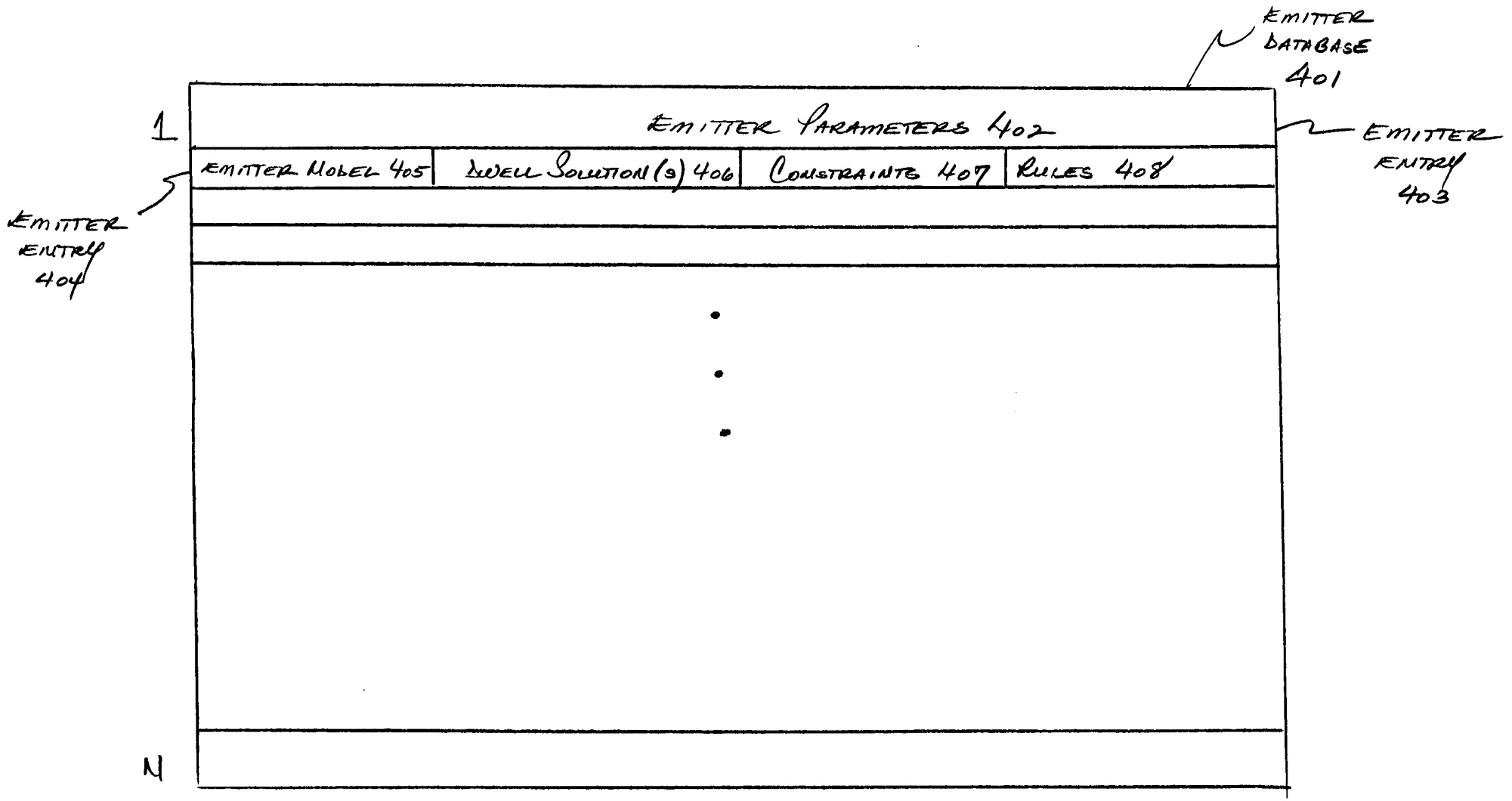

EMITTER DATABASE 401
1
EMITTER PARAMETERS 402
EMITTER ENTRY 403
EMITTER MODEL 405
DWELL SOLUTION(S) 406
CONSTRAINTS 407
RULES 408
EMITTER ENTRY 404
N

Figure 4

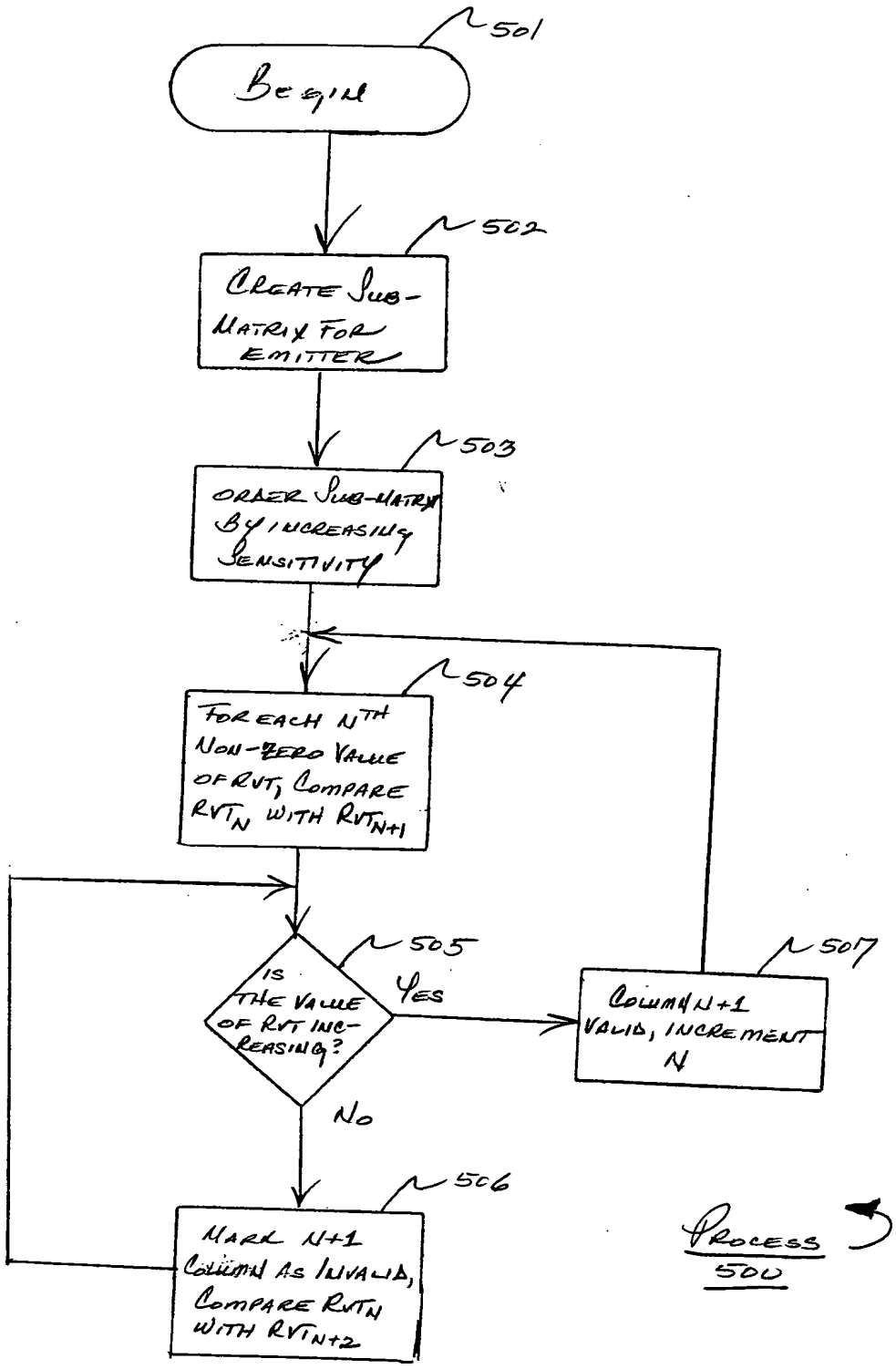

501
Begin
502
Create Sub-Matrix for Emitter
503
Order Sub-Matrix by Increasing Sensitivity
504
For each Nth Non-Zero Value of RVT, Compare RVT_N with RVT_N+1
505
Is the Value of RVT Increasing?
Yes
507
Column N+1 Valid, Increment N
No
506
Mark N+1 Column As Invalid, Compare RVT_N with RVT_N+2
Process 500

Figure 5

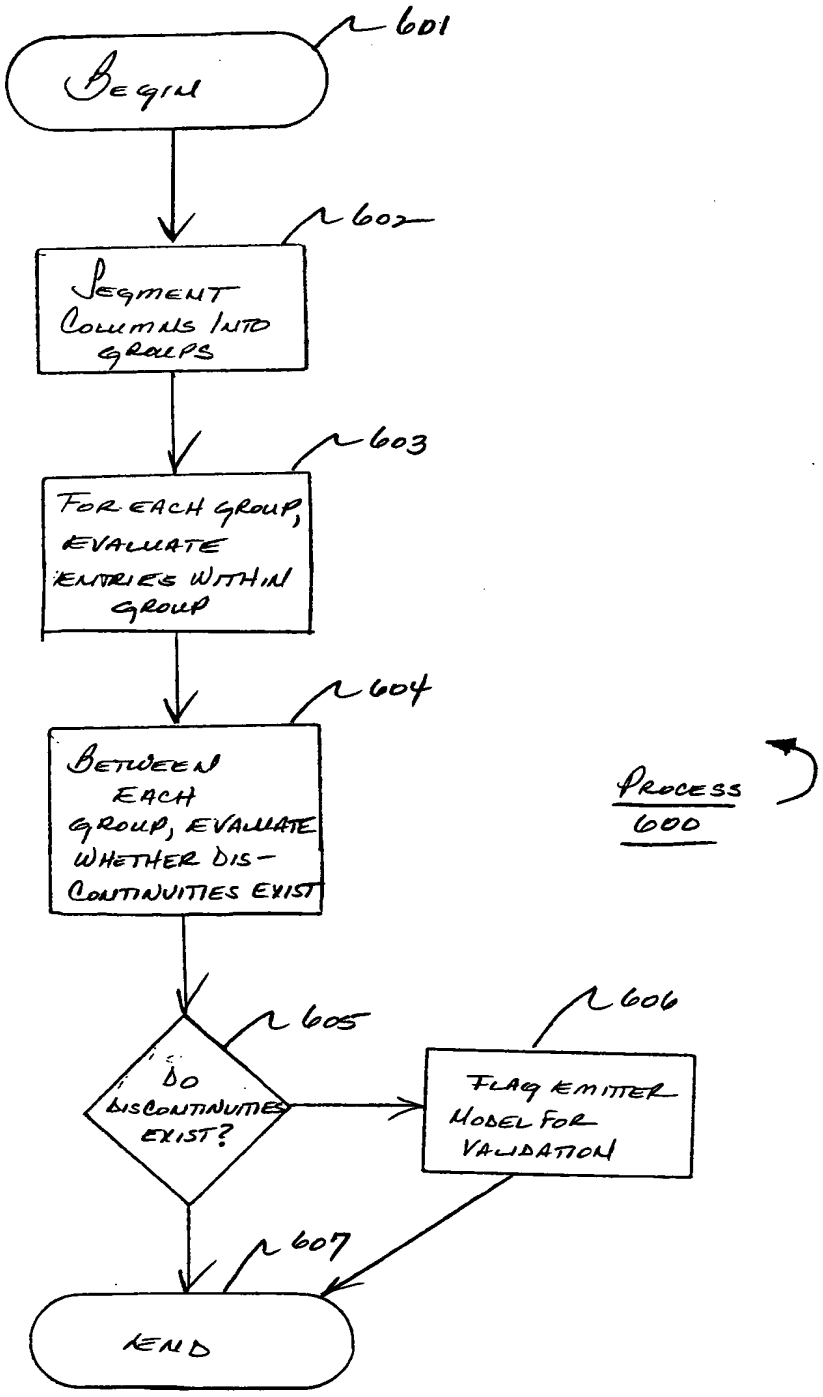

601
Begin
602
Segment Columns Into Groups
603
For each group, evaluate entries within group
604
Between each group, evaluate whether dis-continuities exist
605
Do discontinuities exist?
606
Flag emitter model for validation
607
End
Process 600

Figure 6

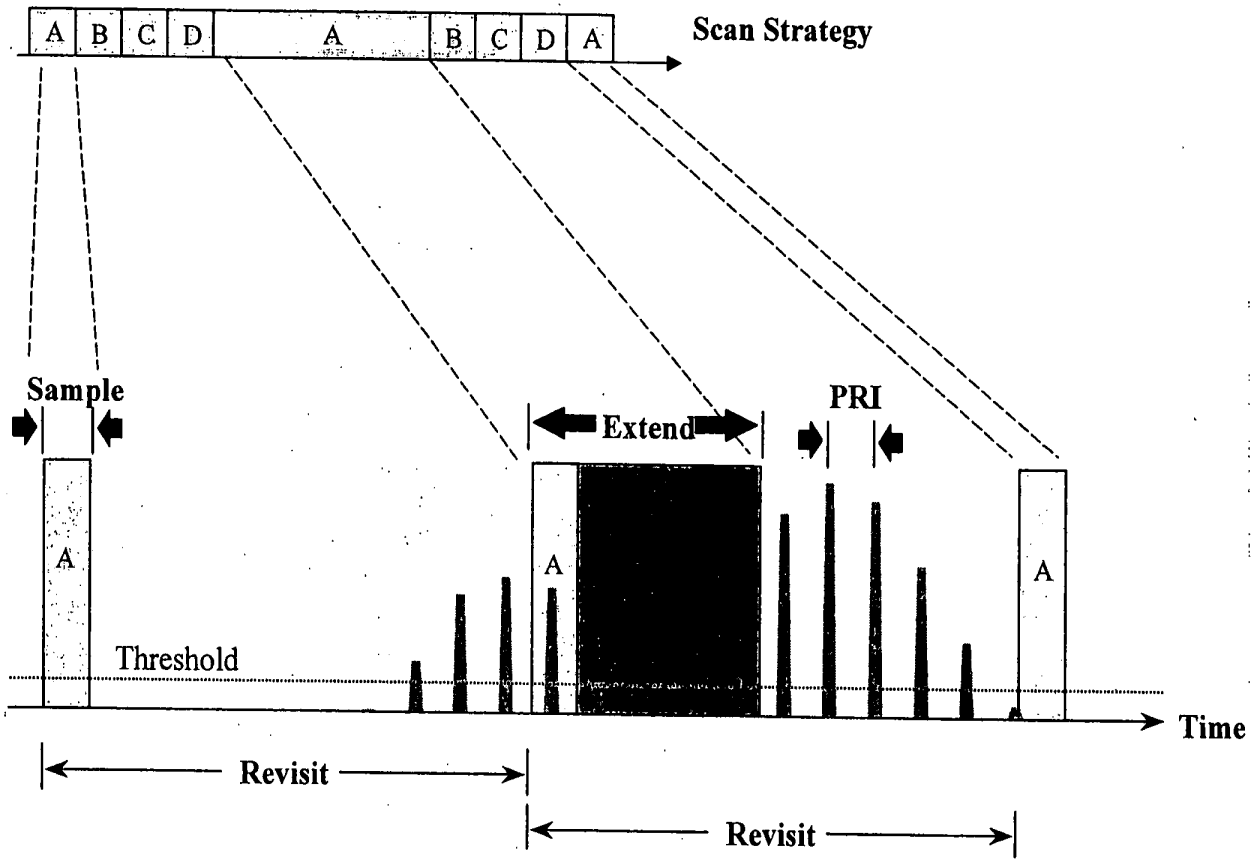

A
B
C
D
A
B
C
D
A
Scan Strategy
Sample
Extend
PRI
A
A
A
Threshold
Time
Revisit
Revisit

FIGURE 7

FIGURE 8A

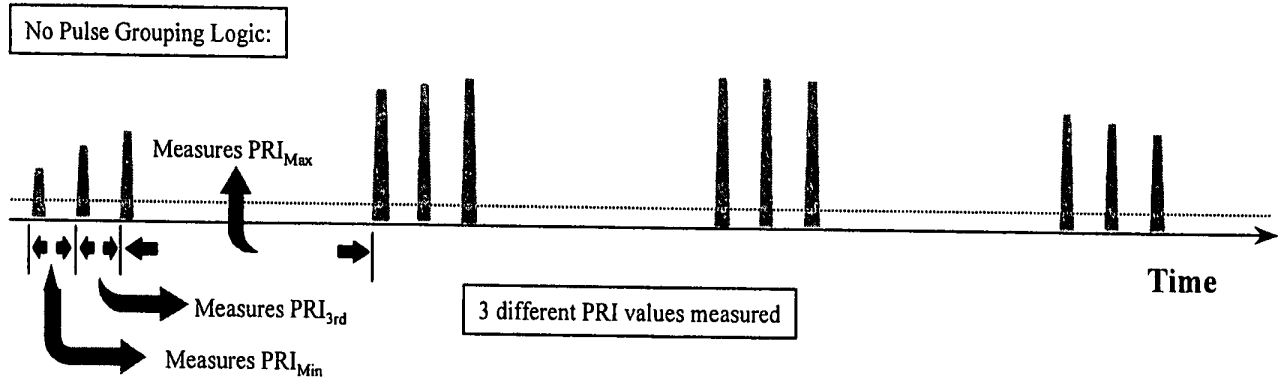
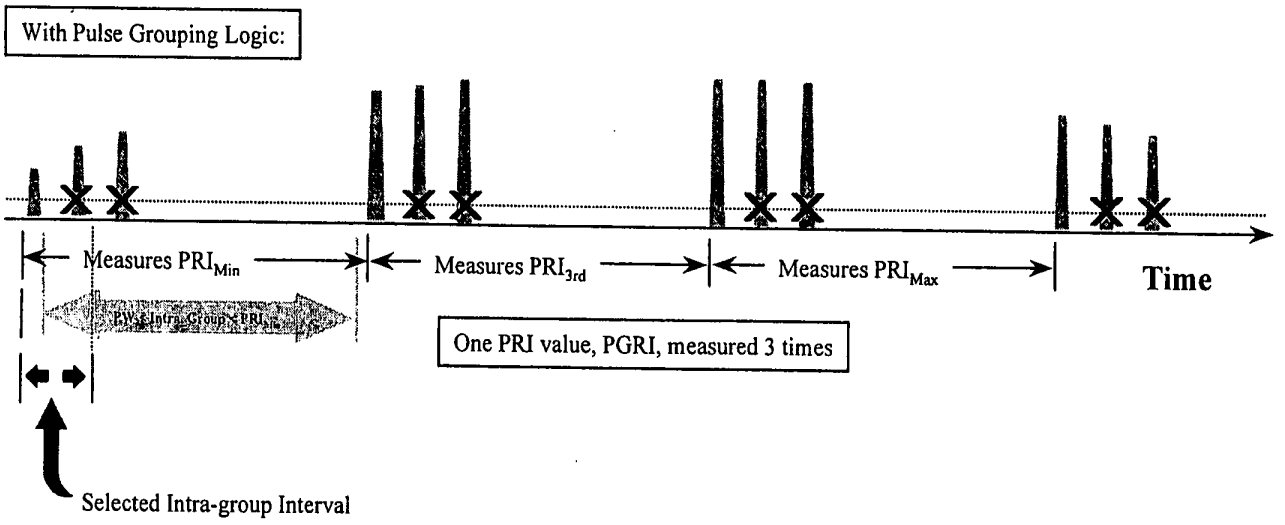


FIGURE 8B



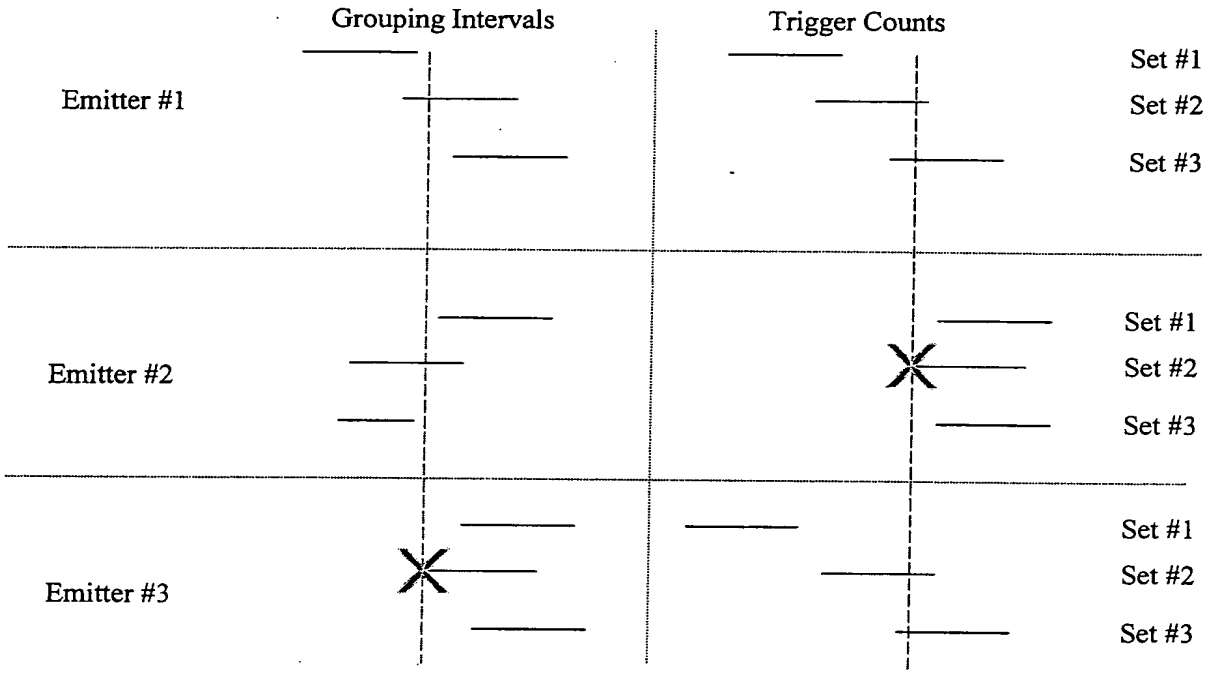
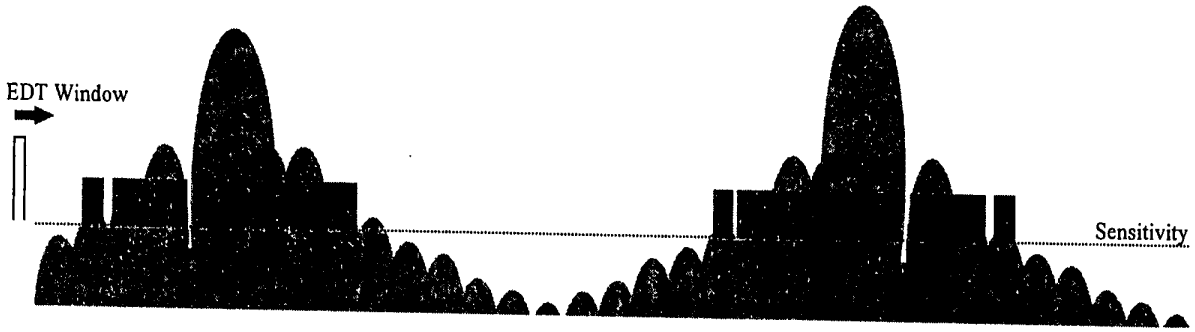

Grouping Intervals
Trigger Counts
Emitter #1
Set #1
Set #2
Set #3
Emitter #2
Set #1
Set #2
Set #3
Emitter #3
Set #1
Set #2
Set #3

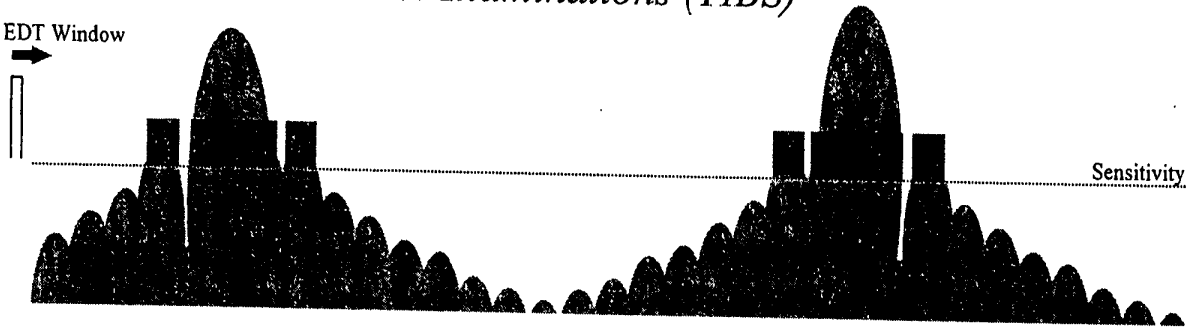
Figure 9

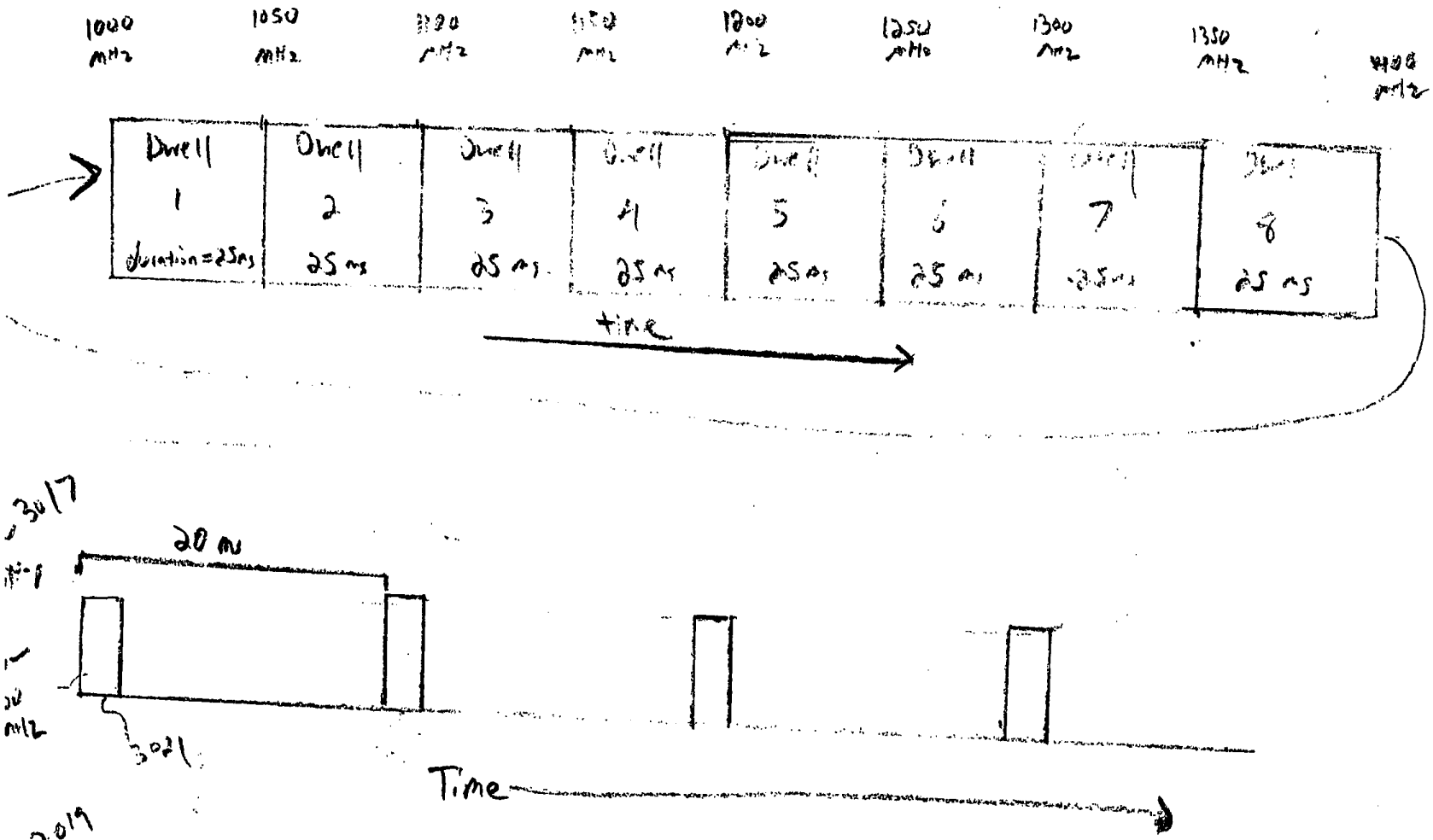
Figure 10A



Discrete Illuminations (TIBS)

Figure 10B




1000 MHz
1050 MHz
1250 MHz
1300 MHz
1350 MHz
Dwell 1
duration = 25 ms
Dwell 2
25 ms
Dwell 3
25 ms
Dwell 5
25 ms
Dwell 6
25 ms
Dwell 7
25 ms
Dwell 8
25 ms
time

3017
20 ms
3021
Time

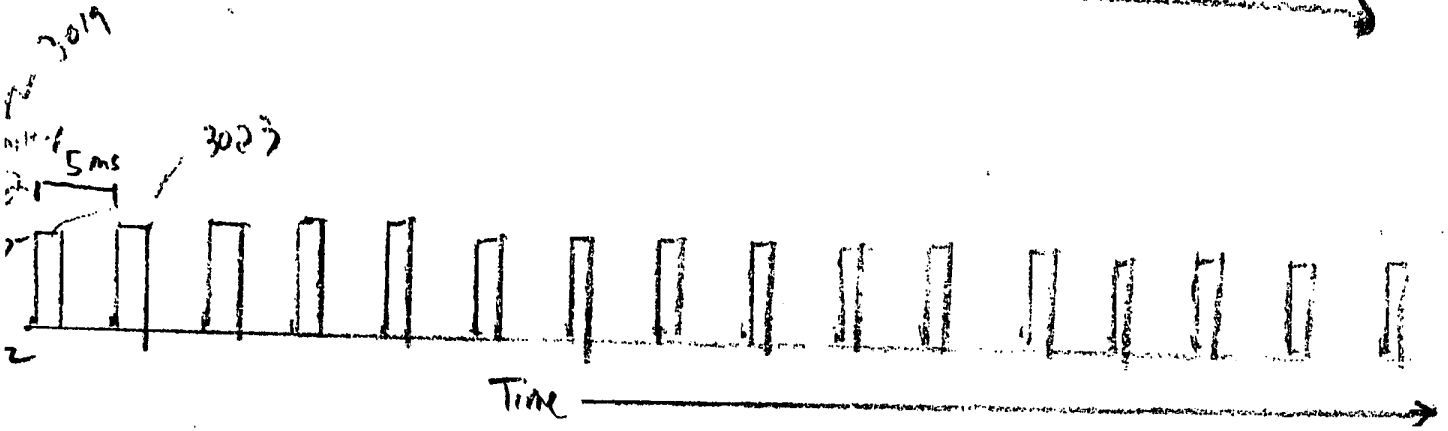

3019
5 ms
3023
Time

Figure 11

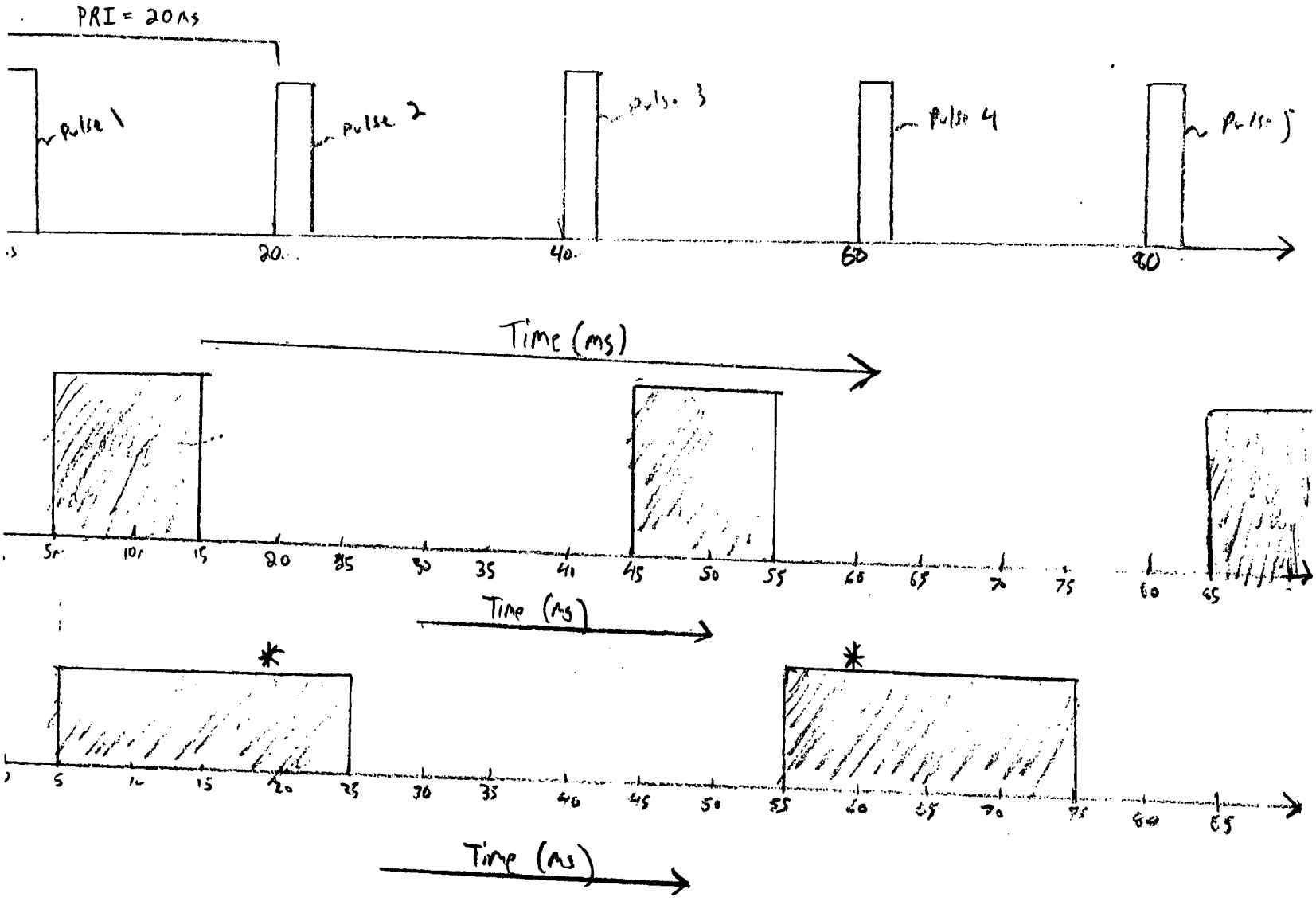
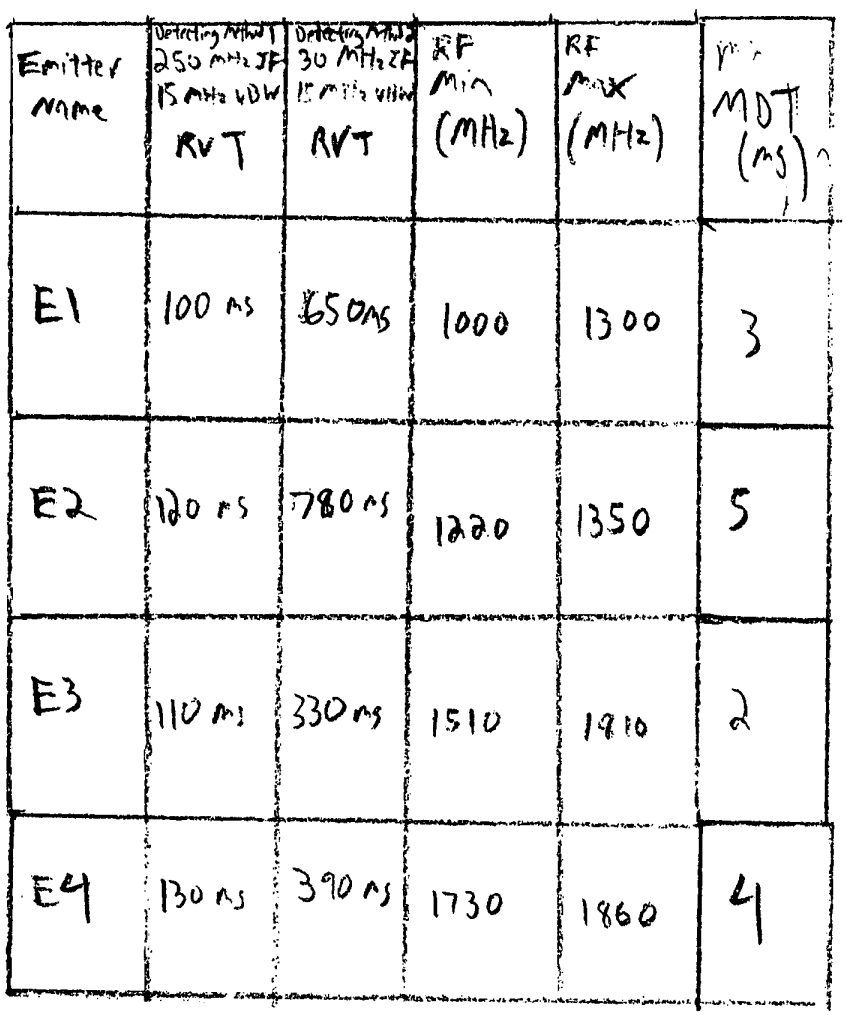

PRI = 20 ms
Pulse 1
Pulse 2
Pulse 3
Pulse 4
Pulse 5
Emitter 3101
Time (ms)
Solution 1
Dwell Duration = 10 ms
Revisit Time = 40 ms
Time (ms)
Solution 2
Dwell Duration = 20 ms
Revisit Time = 50 ms
Time (ms)

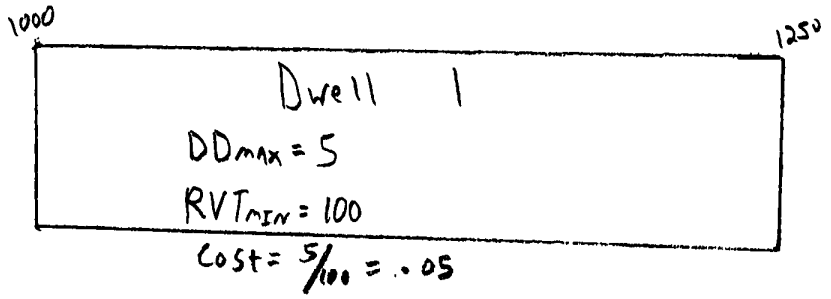
Figure 12



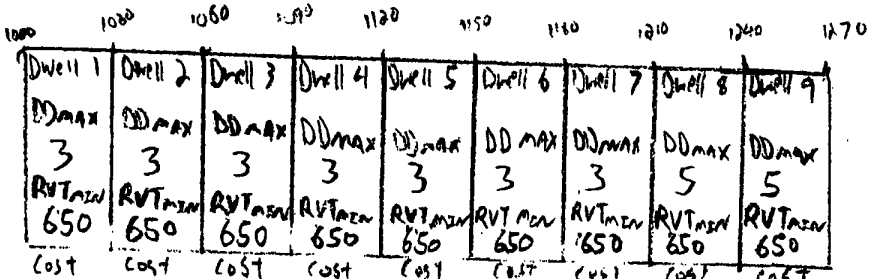
Emitter name	Detecting MHz 1 250 MHz BW 15 MHz VBW RVT	Detecting MHz 2 30 MHz BW 15 MHz VBW RVT	RF Min (MHz)	RF Max (MHz)	PRI MOT (ms)
E1	100 ms	650 ms	1000	1300	3
E2	120 ms	780 ms	1220	1350	5
E3	110 ms	330 ms	1510	1910	2
E4	130 ms	390 ms	1730	1860	4

4000

Figure 13

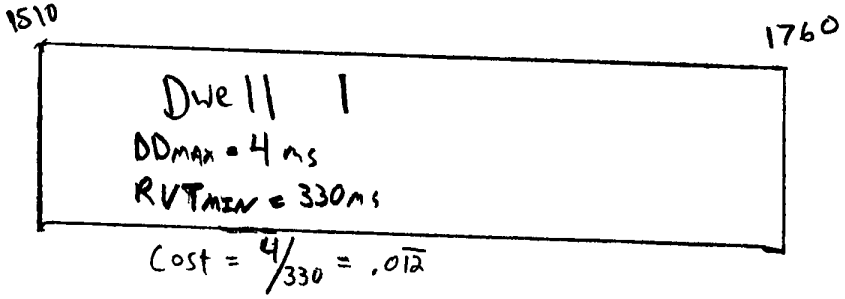


Solution 1

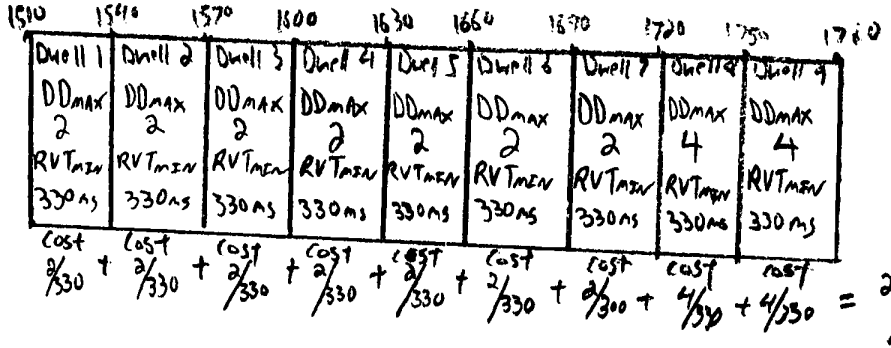


Solution 2

Figure 14A



Solution 1



Solution 2

Figure 14B

Figure 15

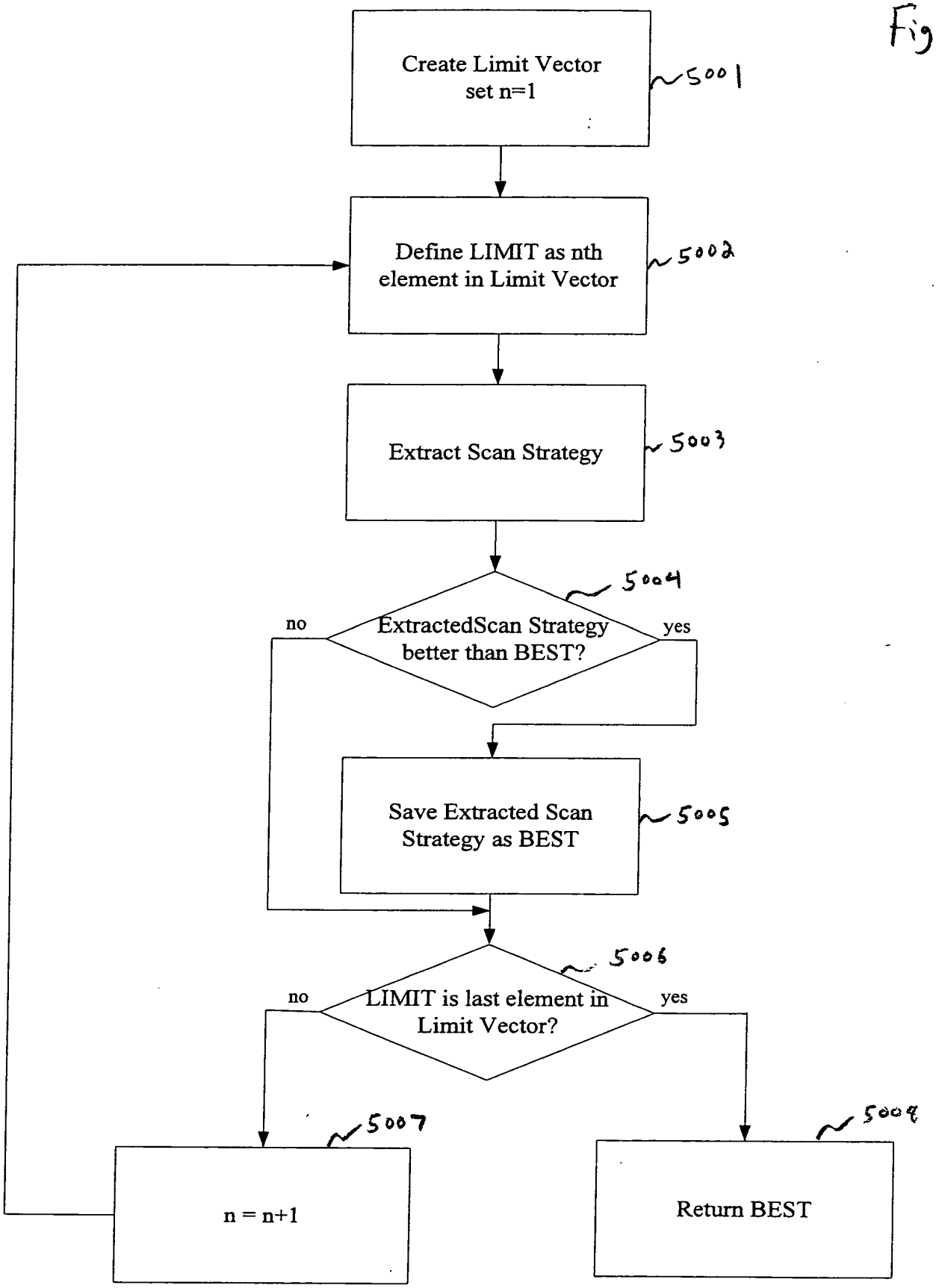
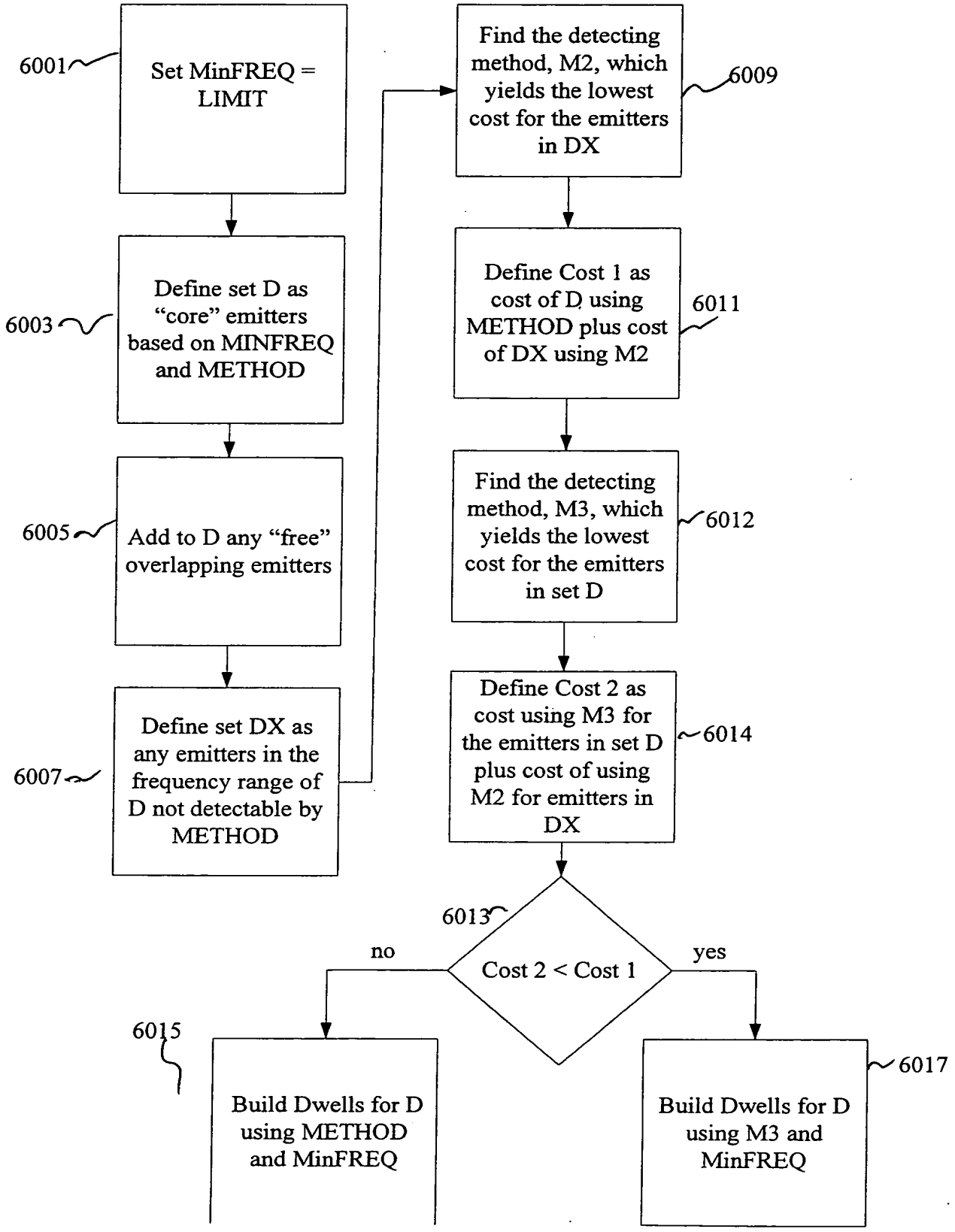

Create Limit Vector
set n=1
5001
Define LIMIT as nth
element in Limit Vector
5002
Extract Scan Strategy
5003
5004
ExtractedScan Strategy
better than BEST?
no
yes
Save Extracted Scan
Strategy as BEST
5005
5006
LIMIT is last element in
Limit Vector?
no
yes
5007
n = n+1
5008
Return BEST

Figure 16


6001
Set MinFREQ = LIMIT
6003
Define set D as "core" emitters based on MINFREQ and METHOD
6005
Add to D any "free" overlapping emitters
6007
Define set DX as any emitters in the frequency range of D not detectable by METHOD
6009
Find the detecting method, M2, which yields the lowest cost for the emitters in DX
6011
Define Cost 1 as cost of D using METHOD plus cost of DX using M2
6012
Find the detecting method, M3, which yields the lowest cost for the emitters in set D
6014
Define Cost 2 as cost using M3 for the emitters in set D plus cost of using M2 for emitters in DX
6013
Cost 2 < Cost 1
no
yes
6015
Build Dwells for D using METHOD and MinFREQ
6017
Build Dwells for D using M3 and MinFREQ

Name	RF Min	RF Max
E1	1100	1200
E2	1150	1250

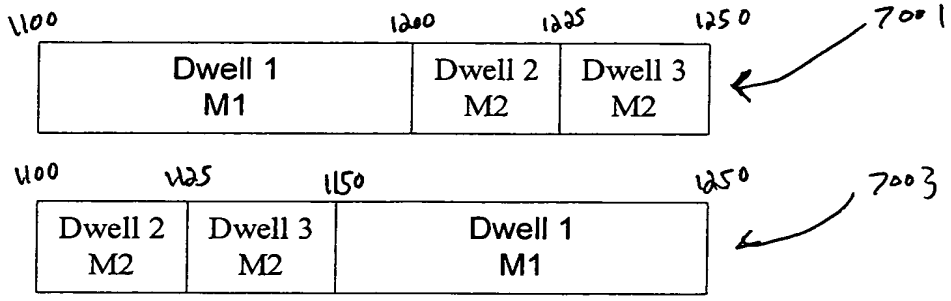


Figure 17

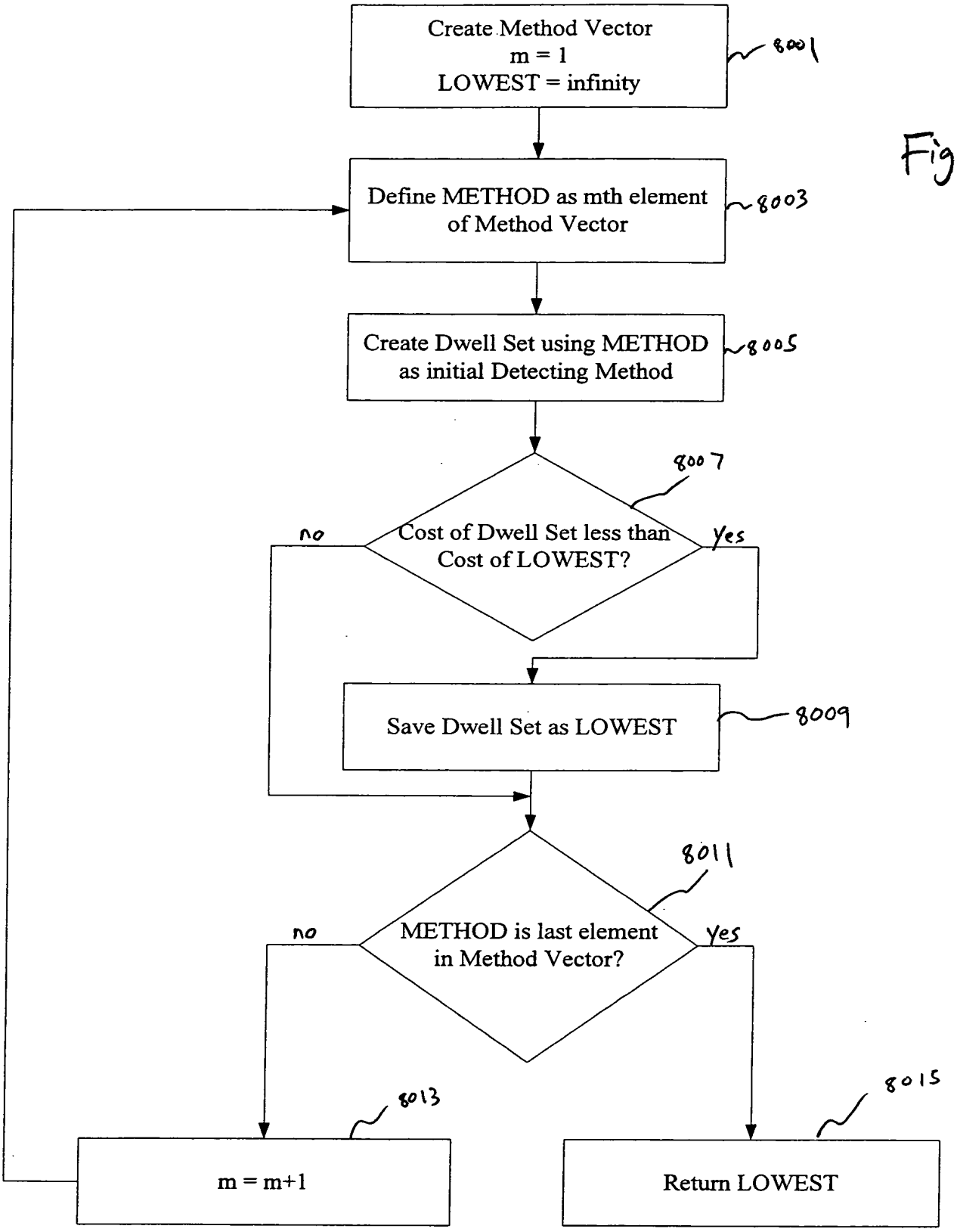

Create Method Vector
m = 1
LOWEST = infinity
8001
Define METHOD as mth element of Method Vector
8003
Create Dwell Set using METHOD as initial Detecting Method
8005
8007
Cost of Dwell Set less than Cost of LOWEST?
no
Yes
Save Dwell Set as LOWEST
8009
8011
METHOD is last element in Method Vector?
no
Yes
8013
m = m+1
8015
Return LOWEST

Figure 18

Emitter	Dwell Duration (ms)	Revisit Time (ms)
Emitter 1	1	500
Emitter 2	2	1200

Figure 19

Emitter	Dwell Duration (ms)	Revisit Time (ms)	Cost
Emitter 1	1	500	.002
Emitter 2	5	1000	.005

Figure 20

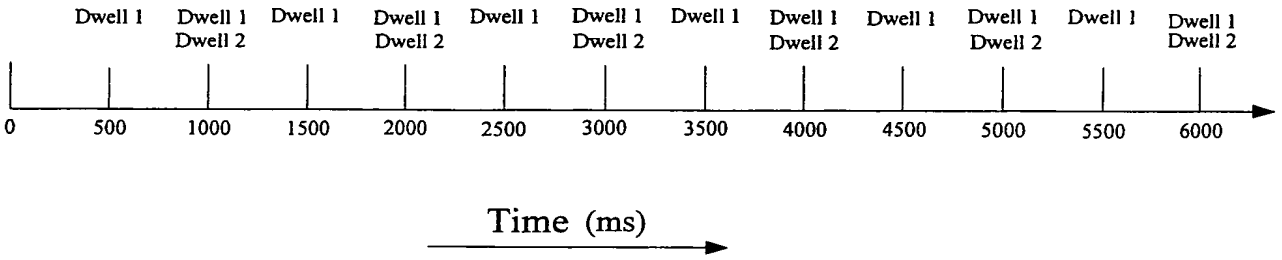

Dwell 1
Dwell 1
Dwell 2
Dwell 1
Dwell 1
Dwell 2
Dwell 1
Dwell 1
Dwell 2
Dwell 1
Dwell 1
Dwell 2
Dwell 1
Dwell 1
Dwell 2
Dwell 1
Dwell 1
Dwell 1
Dwell 2
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Time (ms)

Figure 21

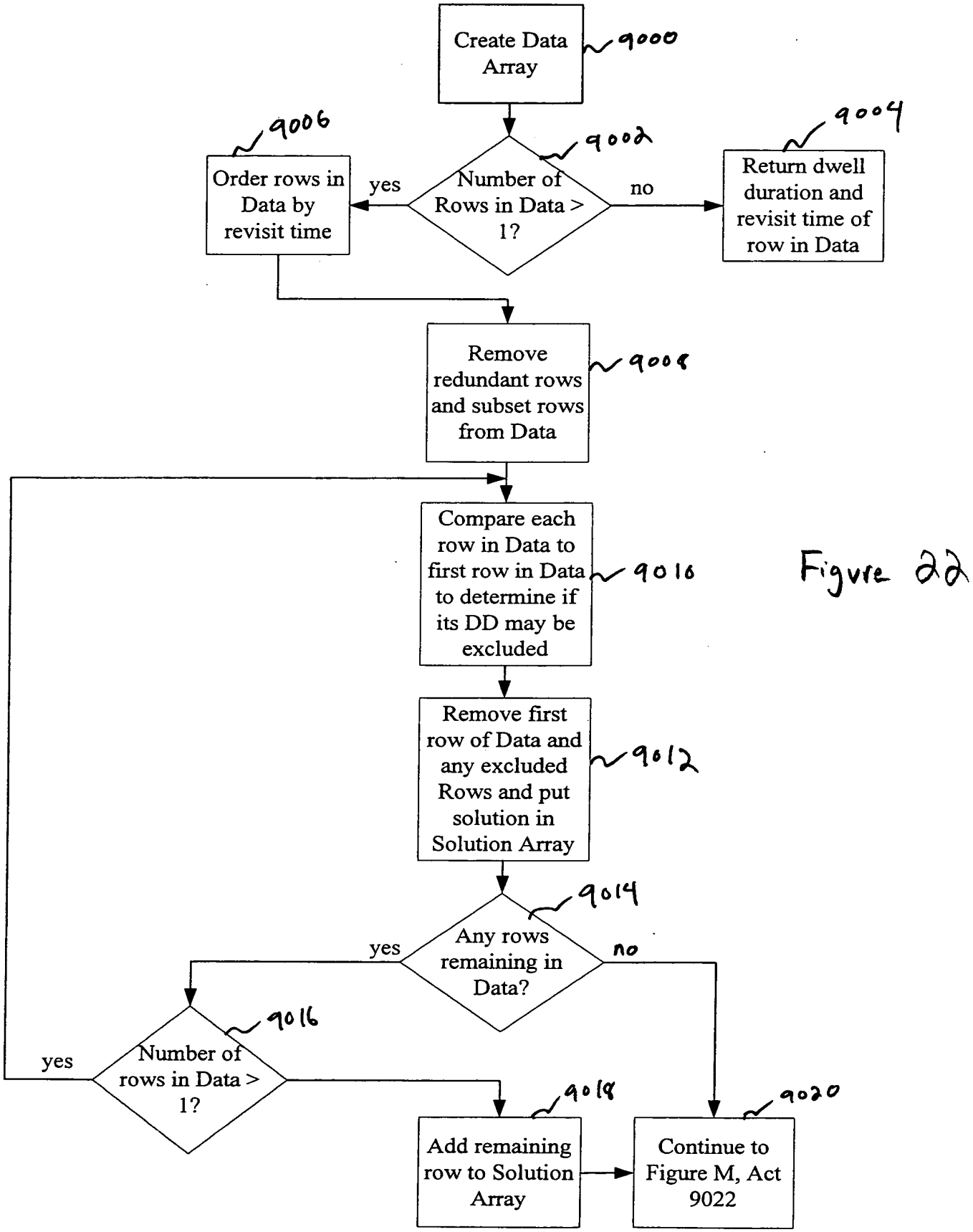

Create Data Array
9000
Number of Rows in Data > 1?
9002
yes
no
Order rows in Data by revisit time
9006
Return dwell duration and revisit time of row in Data
9004
Remove redundant rows and subset rows from Data
9008
Compare each row in Data to first row in Data to determine if its DD may be excluded
9010
Remove first row of Data and any excluded Rows and put solution in Solution Array
9012
Any rows remaining in Data?
9014
yes
no
Number of rows in Data > 1?
9016
yes
Add remaining row to Solution Array
9018
Continue to Figure M, Act 9022
9020

Figure 22

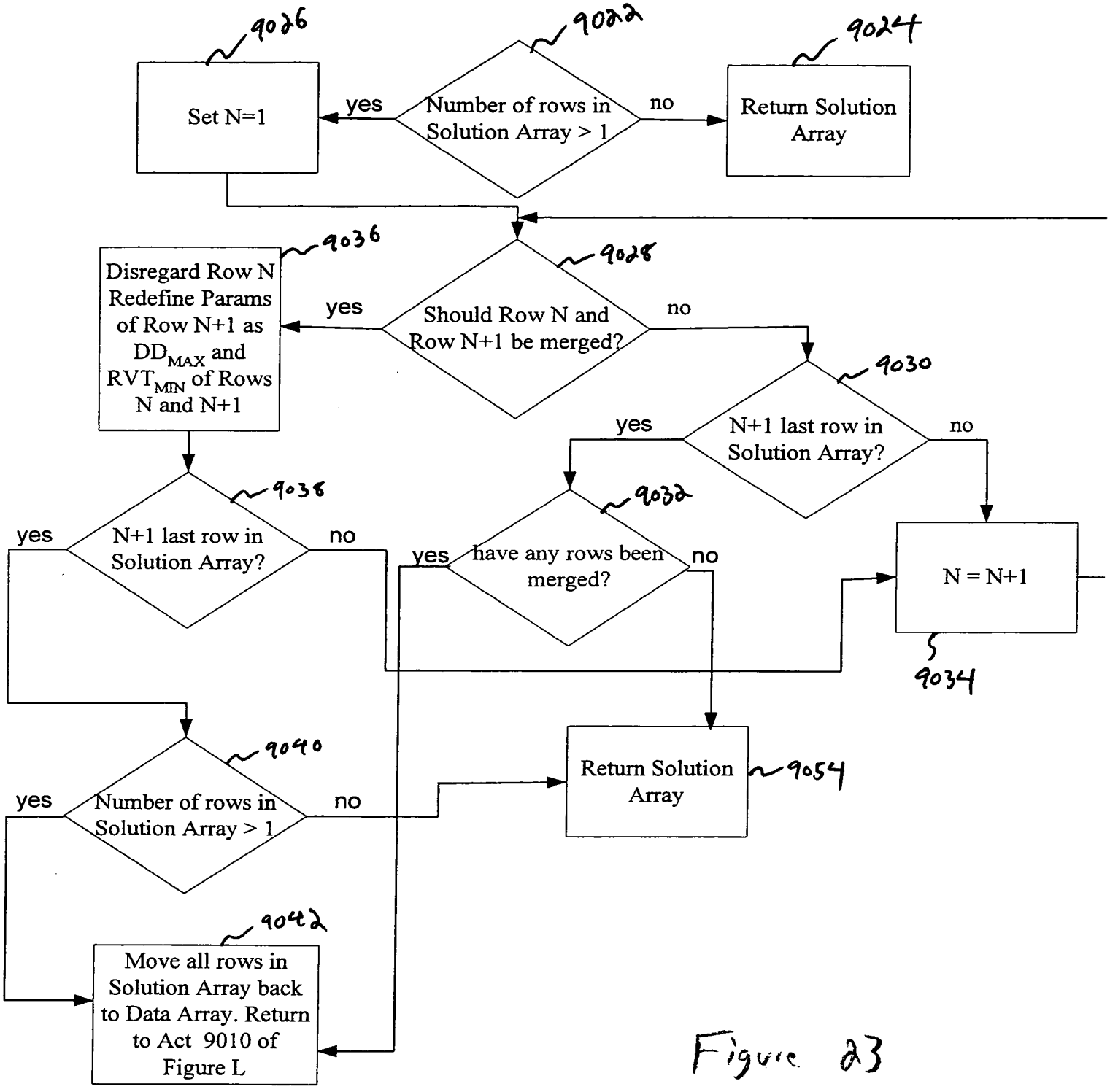

9026
Set N=1
9022
Number of rows in Solution Array > 1
yes
no
9024
Return Solution Array
9036
Disregard Row N Redefine Params of Row N+1 as DD_{MAX} and RVT_{MIN} of Rows N and N+1
9028
Should Row N and Row N+1 be merged?
yes
no
9030
N+1 last row in Solution Array?
yes
no
9038
N+1 last row in Solution Array?
yes
no
9032
have any rows been merged?
yes
no
N = N+1
9034
9040
Number of rows in Solution Array > 1
yes
no
Return Solution Array
9054
9042
Move all rows in Solution Array back to Data Array. Return to Act 9010 of Figure L

Figure 23

9044

Data		
MDT	EDT	RVT
3.05	17	2868
3	19	2000
3	19	2000
1	7	500
2	9	700
2.3	11	800
0.5	3.5	1000

Figure 24A

9044

Data		
MDT	EDT	RVT
1	7	500
2	9	700
2.3	11	800
0.5	3.5	1000
3	19	2000
3	19	2000
3.05	17	2868

9048
9049
9050

Figure 24B

Data		
MDT	EDT	RVT
1	7	500
2	9	700
2.3	11	800
3	19	2000
3.05	17	2868

9051
9052

Figure 24C

9044

Data		
MDT	EDT	RVT
2	9	700
2.3	11	800

9046

Solution		
MDT	EDT	RVT
1	19	500

Figure 24D

9044

Data		
MDT	EDT	RVT

9046

Solution		
MDT	EDT	RVT
1	19	500
2	11	700

Figure 24E

9046

Solution		
MDT	EDT	RVT
1	19	500
2	11	700

Figure 24F

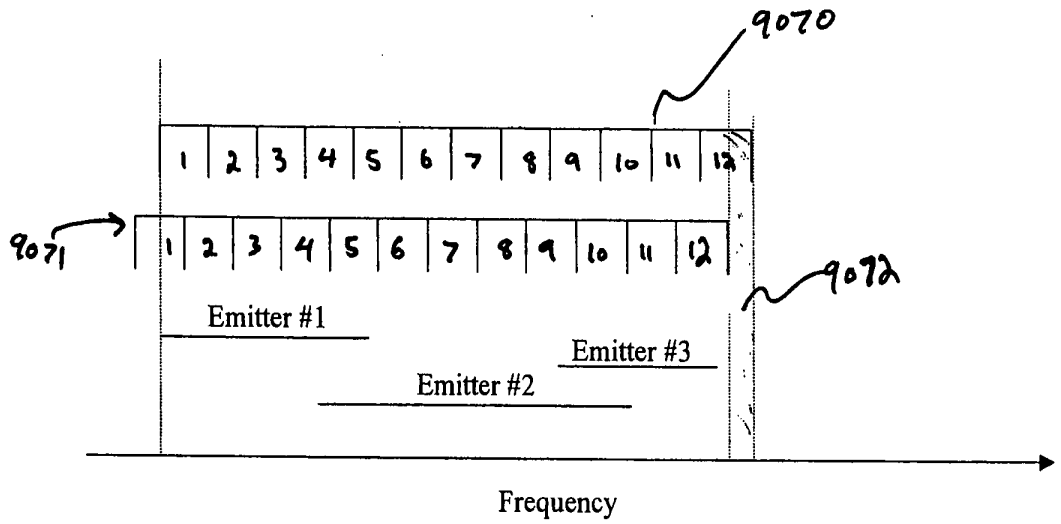

9070
1 2 3 4 5 6 7 8 9 10 11 12
9071
1 2 3 4 5 6 7 8 9 10 11 12
9072
Emitter #1
Emitter #3
Emitter #2
Frequency

Figure 25

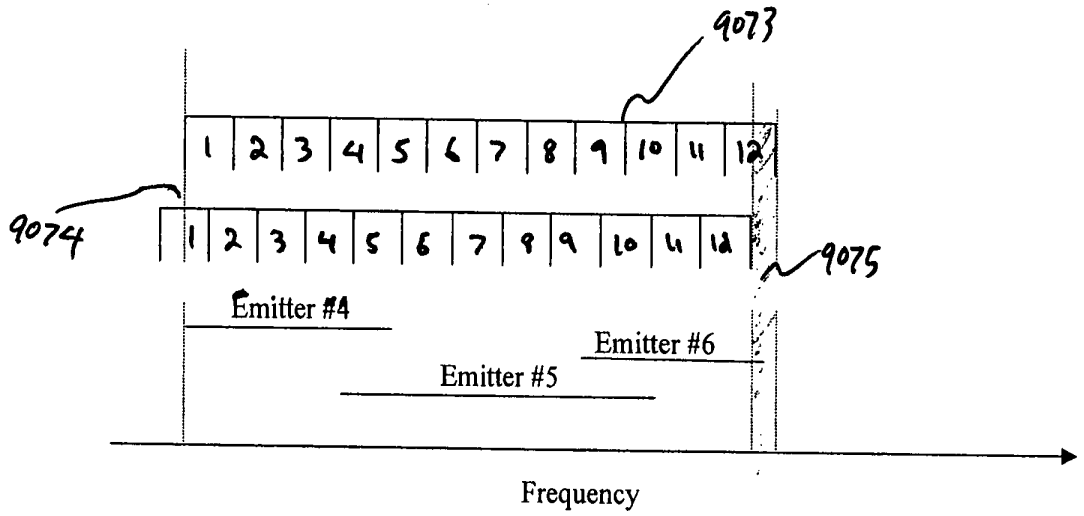

9073
1 2 3 4 5 6 7 8 9 10 11 12
9074
1 2 3 4 5 6 7 8 9 10 11 12
9075
Emitter #4
Emitter #6
Emitter #5
Frequency

Figure 26

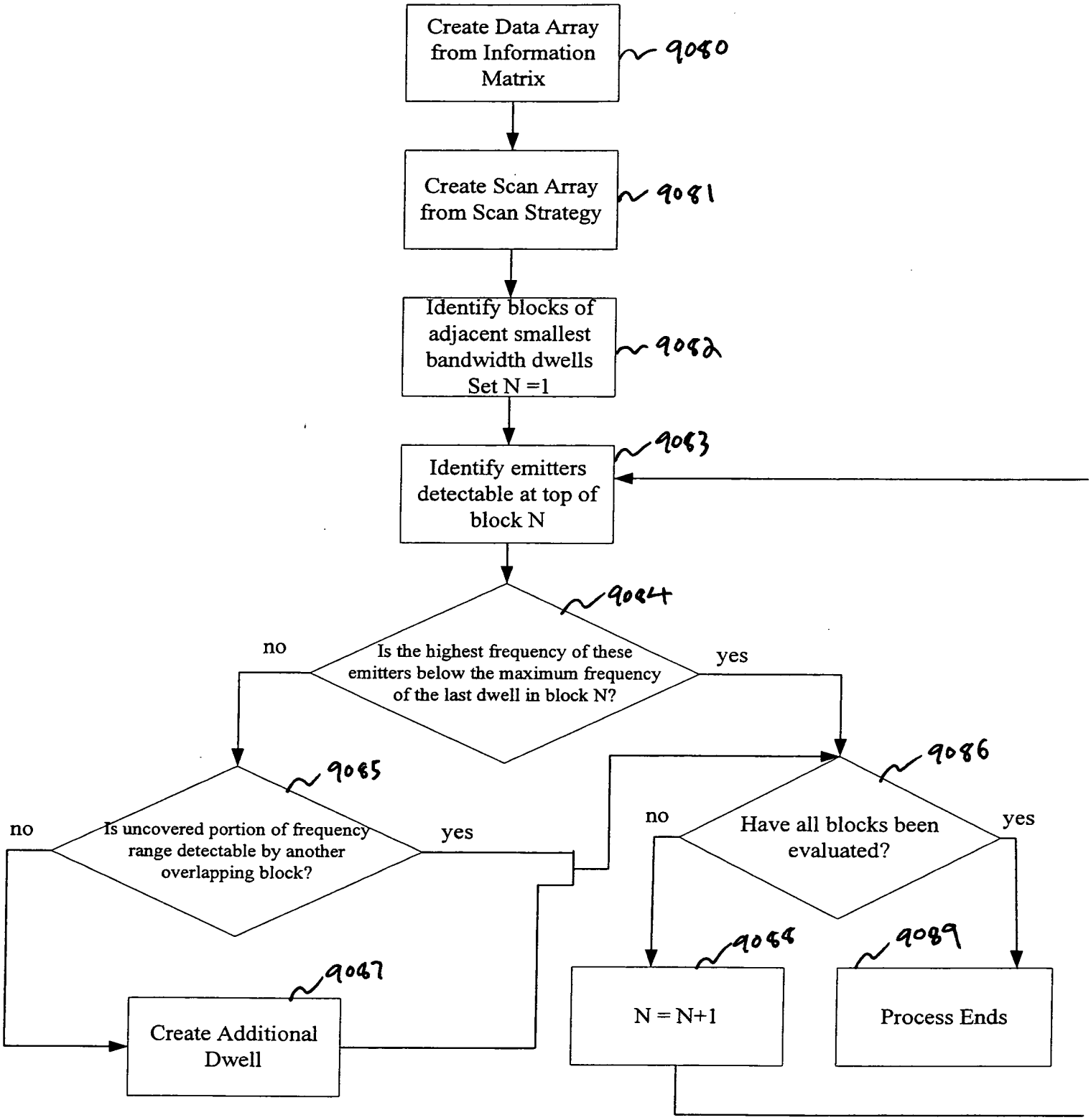

Create Data Array from Information Matrix
9080
Create Scan Array from Scan Strategy
9081
Identify blocks of adjacent smallest bandwidth dwells Set N =1
9082
Identify emitters detectable at top of block N
9083
Is the highest frequency of these emitters below the maximum frequency of the last dwell in block N?
9084
no
yes
Is uncovered portion of frequency range detectable by another overlapping block?
9085
no
yes
Have all blocks been evaluated?
9086
no
yes
Create Additional Dwell
9087
N = N+1
9088
Process Ends
9089

Figure 27

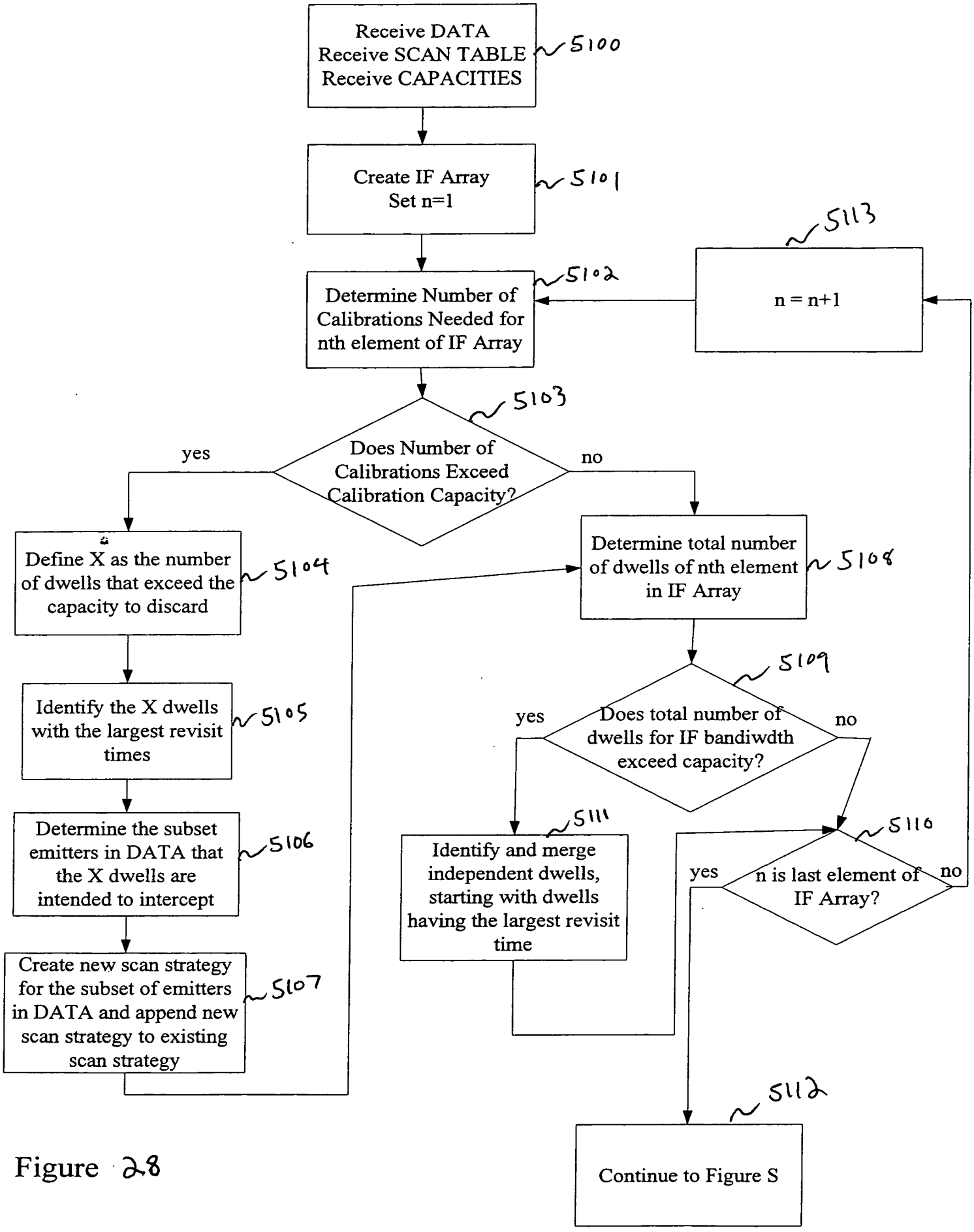

Receive DATA
Receive SCAN TABLE
Receive CAPACITIES
5100
Create IF Array
Set n=1
5101
5113
n = n+1
5102
Determine Number of Calibrations Needed for nth element of IF Array
5103
Does Number of Calibrations Exceed Calibration Capacity?
yes
no
Define X as the number of dwells that exceed the capacity to discard
5104
Identify the X dwells with the largest revisit times
5105
Determine the subset emitters in DATA that the X dwells are intended to intercept
5106
Create new scan strategy for the subset of emitters in DATA and append new scan strategy to existing scan strategy
5107
Determine total number of dwells of nth element in IF Array
5108
5109
Does total number of dwells for IF bandiwdth exceed capacity?
yes
no
5111
Identify and merge independent dwells, starting with dwells having the largest revisit time
5110
n is last element of IF Array?
yes
no
5112
Continue to Figure S

Figure 28

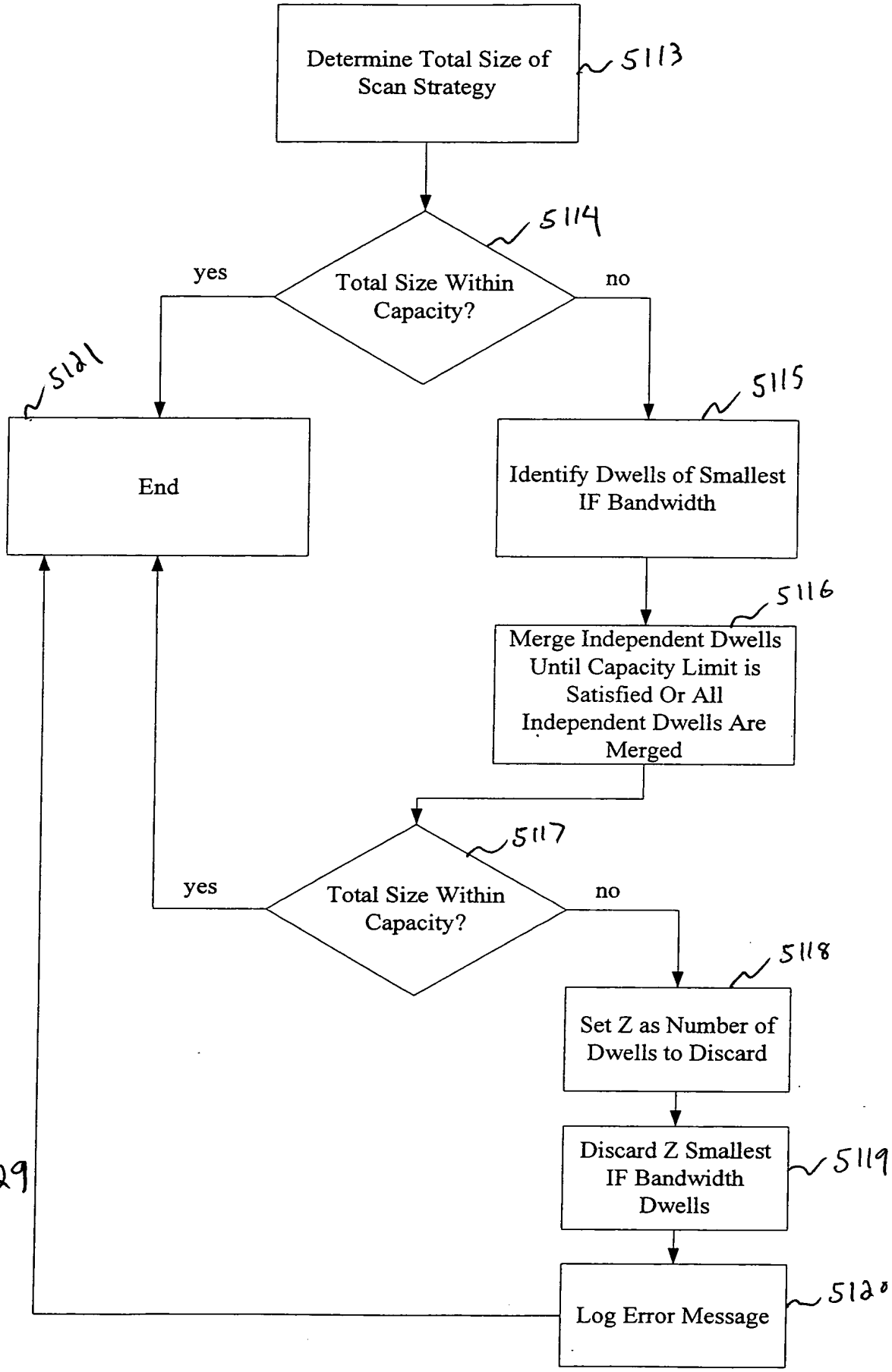

Determine Total Size of Scan Strategy
5113
5114
Total Size Within Capacity?
yes
no
5121
End
5115
Identify Dwells of Smallest IF Bandwidth
5116
Merge Independent Dwells Until Capacity Limit is Satisfied Or All Independent Dwells Are Merged
5117
Total Size Within Capacity?
yes
no
5118
Set Z as Number of Dwells to Discard
Discard Z Smallest IF Bandwidth Dwells
5119
Log Error Message
5120

Figure 29

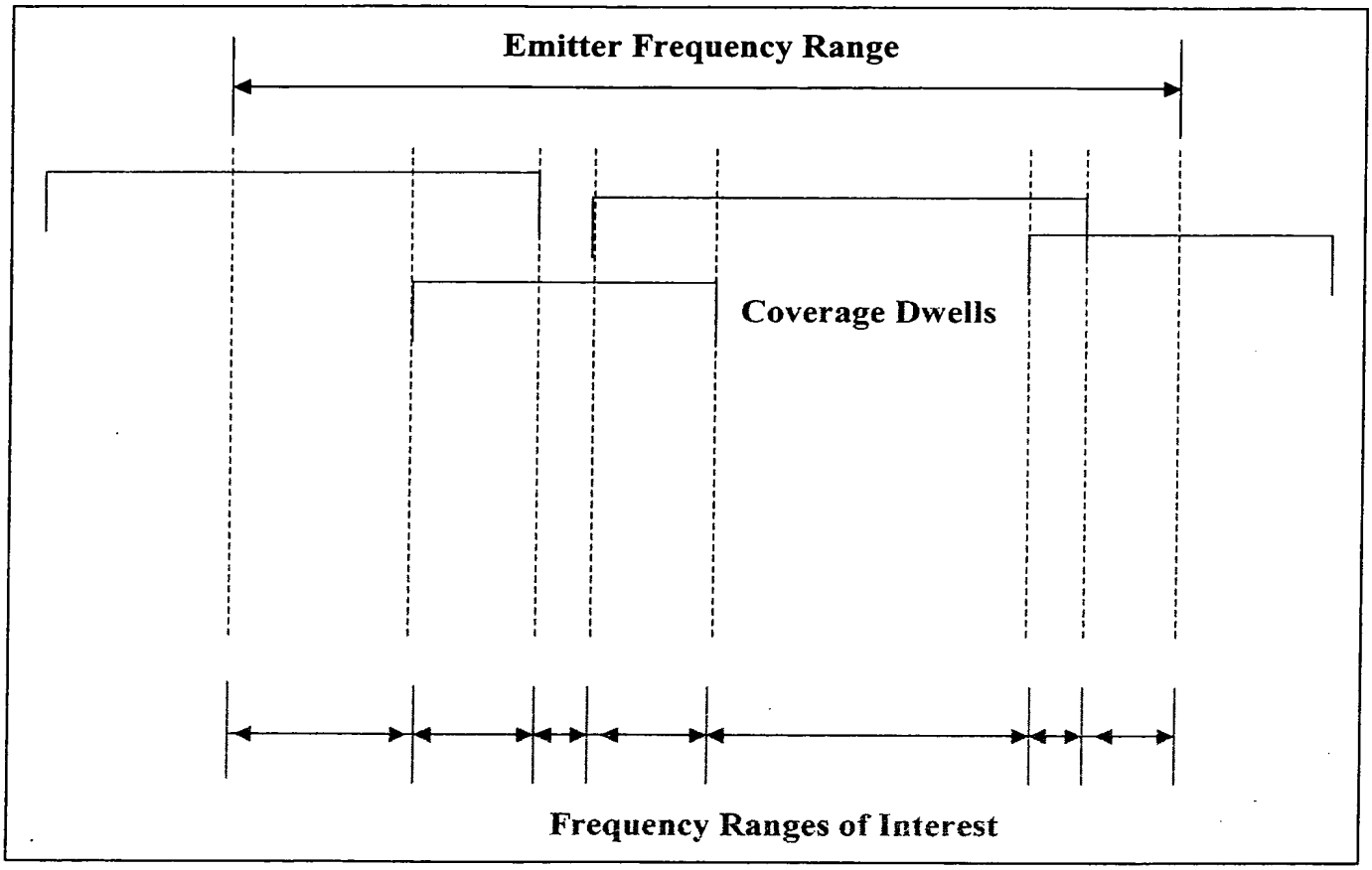

Emitter Frequency Range
Coverage Dwells
Frequency Ranges of Interest

Figure 30

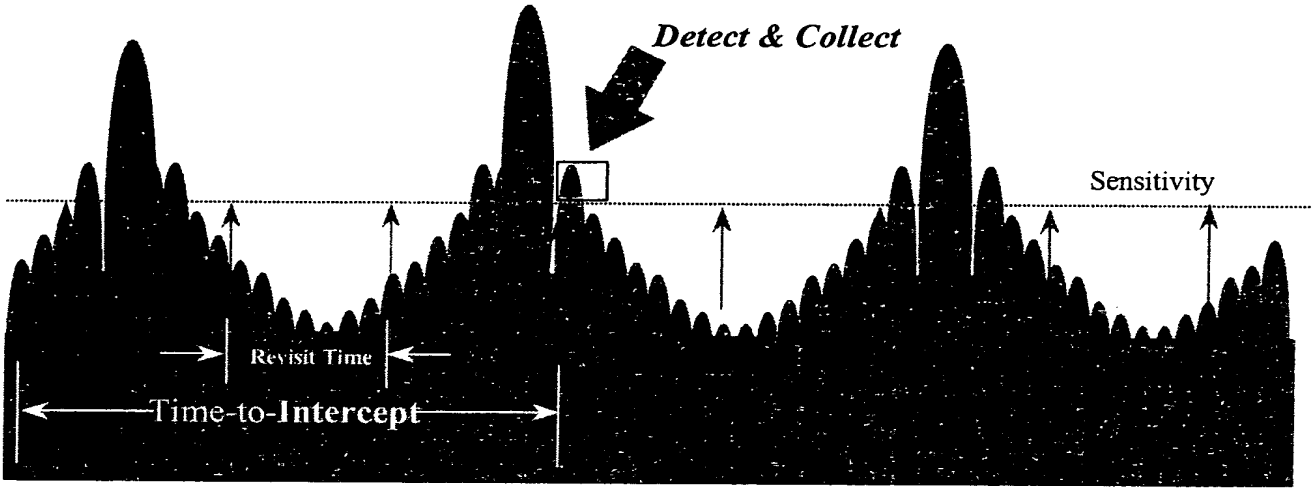

Detect & Collect
Sensitivity
Revisit Time
Time-to-Intercept

Figure 31

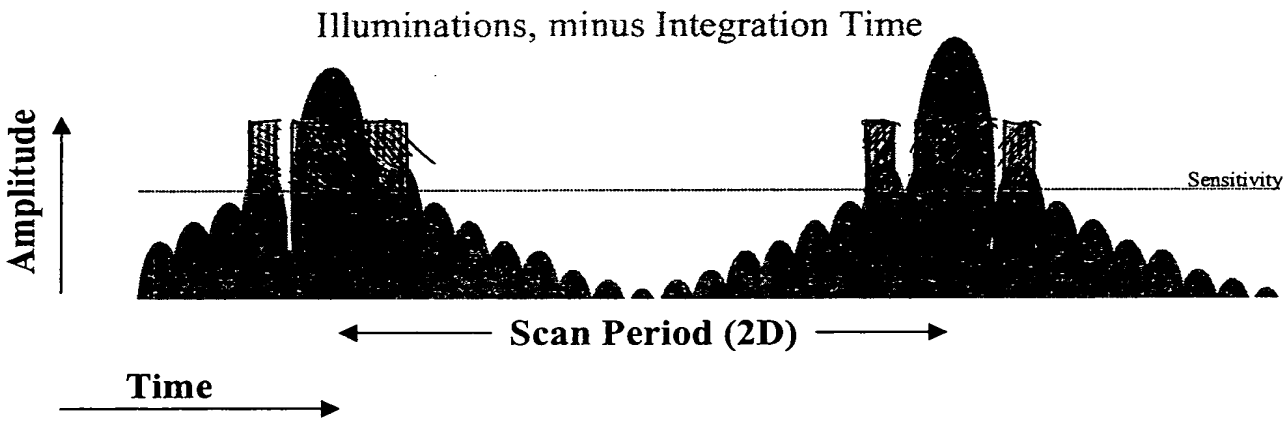

Illuminations, minus Integration Time
Amplitude
Sensitivity
Scan Period (2D)
Time

Figure 32